

Sammy's Loose Roof Decisions

Instructor's Copy

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&

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Introduction

This document contains most of the materials needed to use the exercise. The main part of the document is the instructor's copy. It tells how to use the exercise, presents the objectives, the master answer sheet, the scoring key, and discussion notes to be used following the exercise. The last part of this document is four appendices. Appendix A is the exercise problem booklet. This booklet can be duplicated locally. The booklets are reusable. One is needed for every person in the classroom. Appendix B is the answer sheet. Copies of this answer sheet must have the invisible ink answers that appear in Appendix C printed on them². Answer sheets are consumable. One is needed for each person or each small group of 3 to 5 persons who work the exercise. Appendix D contains the 3-D color slides that accompany the exercise.

Exercise Summary

Read this section first. It determines if the exercise is appropriate for your classes. If you choose to use the exercise, examine the table of contents and review the remainder of this document.

Type: Invisible ink

Length: Eight questions (30 minutes administration plus 30 minutes for discussion)

Skills: Recognition of roof and rib hazards
Knowledge of methods for control of cutter roof

Location: Underground

Problem: During your routine survey work as a transitman, you observed in recent weeks that an idle section in 2 North mains, about 3 miles from the portal, has been experiencing serious roof problems. You were told by one of the mine engineers that the problems are due to the sudden presence of slips in the roof running in the direction of mining. Several falls and significant downtime have forced the company to reconsider the development of 2 North. On this particular day the general superintendent informs you and your helper that the company decided to reactivate the idled section beginning next shift. You are to enter the mine and set sights in 2 North to re-orient all the entries by 45 degrees to the east before the regular daylight crew arrives. You are just beginning your work when you notice a section of top lower than the surrounding area. You must decide whether there is a problem that can wait or if it should be taken care of immediately.

² You can do this yourself if you have the proper equipment, or you may obtain copies of preprinted answer sheets from MSHA, National Mine Health & Safety Academy, Dept. of Instructional Materials, 1301 Airport Road, Beaver, WV 25813-9426 phone 304-256-3257, fax 304-256-3368 or email to lord-mary@msha.gov.

How to Use This Exercise

1. Look at the performance objectives. Decide if the exercise is relevant for your mine training class.
2. Work through the exercise with the developing pen and score your responses.
3. Read the master answer sheet for the exercise. Look at all the answers.
4. Read the "Instructor's Discussion Notes" for the exercise.
5. Become thoroughly familiar with the problem so that you can present it to your class without reading it.
6. When you present the exercise to the class:
 - Give each person an exercise booklet, a set of 3-D slides, and a 3-D viewer, and each group of 3 to 5 persons one answer sheet and a developing pen.
 - Demonstrate how to select and mark answers using the developing pen, and how to use the 3-D viewer.
 - Go over the instructions for doing the exercise with the whole group.
 - Explain the problem making sure everyone understands the problem situation.
 - Have the class members work the exercise.
 - When the class members finish, have them figure up their score using the instructions at the end of the exercise.
 - When everyone has finished, discuss the exercise. Let class members discuss the merits of each answer. Add your own ideas.

Performance Objectives for Sammy's Loose Roof Decisions

Objective number	Capability verb(s)	Description of required performance and conditions under which it is to occur
1. HR ³	Recognize	Existing roof hazards and conditions that can lead to hazards
2. HR	Identify	Cues that indicate potential ground hazards
3. HR	Discriminate Assess	Roof conditions that may be hazardous and require some type of action
4. GC	Recall Comprehend	Basic information on the causes of cutter roof and facts regarding its control
5. AP	Choose	From alternative actions, the most appropriate means to prevent undue risk to other miners

³ Skill and knowledge domain abbreviations:
AP = accident prevention
GC = ground control
HR = hazard recognition

Master Answer Sheet for Sammy's Loose Roof Decisions

Use this answer sheet to mark your selections. Rub the developing pen gently and smoothly between the brackets. Don't scrub the pen or the message may blur. Be sure to color in the entire message once you have made a selection. Otherwise you may not get the information you need.

Question A (Select as MANY as you think are correct)

1. [This problem should have been noticed a long time ago.]
2. [Correct. Absence of rockdust is often a cue that ribs are taking on vertical pressures.]
3. [Correct. This condition indicates that those particular bolts can no longer effectively support the roof.]
4. [High bolted roof indicates a previous fall that was rebolted following cleanup.]
5. [Correct. This can indicate excessive internal roof pressures.]
6. [Engineers determine bolt types based on makeup of the mine roof and these bolts must be approved in the roof control plan.]

Question B (Select as MANY as you think are correct)

7. [Correct. He looks carefully and the top appears to be OK.]
8. [Sammy should suspect a possible hazard.]
9. [This could be dangerous.]
10. [Correct. It sounds a little drummy, but not too bad.]

Question C (Choose only ONE unless you are told to "Try Again!")

11. [All potential roof hazards should be treated as an immediate problem. Try again!]
12. [You should be concerned for the safety of others as well as your own. Try again!]
13. [Correct. It could fall at any time. Do the next question.]
14. [The shift crew, and others, soon will be moving through this main track entry. Try again!]

Question D (Choose only ONE unless you are told to "Try Again!")

15. [You need to act now. Try again!]
16. [This is dangerous. You don't have the proper tools and equipment.]
[Try again!]
17. [Correct. The bad top needs to be reported right away, but you should stay]
[to warn the miners coming in. Do the next question.]
18. [If you try this, a large section of roof may fall on you. Try again!]
19. [You shouldn't go back under the bad top. Try again!]

Question E (Choose only ONE unless you are told to "Try Again!")

20. [This is unlikely. Try again!]
21. [Correct. Abnormally high stresses at the roof-rib interface have exceeded the]
[shear strength of the rock. This produces the condition known as cutter roof.]
[Do the next question.]
22. [A slip would have a clearly defined break line and would tend to run more]
[toward the center of the entry roof. Try again!]
23. [Poor continuous mining machine operation would not produce a roof pattern]
[like this. Try again!]

Question F (Choose only ONE unless you are told to "Try Again!")

24. [This could be dangerous, particularly for Sammy. Try again!]
25. [Correct. Cutter roof is a serious problem. A large section of top may fall]
[suddenly. Do the next question.]
26. [All potential roof hazards should be treated as serious problems. Try again!]
27. [This could be dangerous and should be done only by experienced miners]
[with the necessary tools and materials. Try again!]

Question G (Select as MANY as you think are correct)

28. [If pillars are not stacked when mining above or below a mined out seam, roof]
[and floor problems can occur. However, the nature of such ground failures]
[are similar to those experienced in a common roof fall.]
29. [Correct. Classic cutter roof failure is usually attributed to high stresses]
[which exceed the shear strength of the rock at the roof-rib interface.]
30. [This generally will increase the vertical stress in the stratified roof and result]
[in tension fractures near the center of the roof span but will not cause cutter]
[roof.]
31. [Correct. Clay veins can lead to cutter roof problems because they represent]
[zones of weakness in the roof strata where the roof can sag and fracture.]
32. [Correct. A strong immediate roof can be loaded by weaker upper strata that]
[may sag and induce cutters.]

Question H (Choose only ONE unless you are told to "Try Again!")

33. [Try again!]
34. [Try again!]
35. [Correct. The cutter will work its way up from the roof-rib interface nearly]
[vertically into the mine roof on one side of the entry. **End of Problem.**]
36. [Try again!]
37. [This is a hazard! However, when additional support is added at the first sign]
[of cutters, the entry roof can become stabilized. Try again!]
38. [Cutter roof can and does occur in mines with many different roof]
[compositions. Try again!]

Finding your score

Number of "Correct" answers you colored in = (1)_____

25 minus number of incorrect answers you colored in = (2)_____

Add blanks one and two to get your total score = (3)_____

Highest possible score = 38

Lowest possible score = 0

Instructor's Discussion Notes for Sammy's Loose Roof Decisions

Use the information presented here and on the master answer sheet, your own ideas and experience, and those of the miners in your class to discuss the exercise after it is completed. Miners frequently think of better ways to respond to a problem than those listed among the answers. The purpose of the exercise is to help miners think about and remember basic knowledge and skills they may someday need to deal with a mine emergency. The discussion following the exercise can contribute to this goal and tailor the exercise content to the needs of the group you are training.

It is helpful to show overhead transparencies of the answers on the master answer sheet during the discussion, while the miners look at their problem booklets. This allows you to lead the group through the exercise and to discuss all the answers to each question. Most of the information about why particular answers are correct or incorrect is given on the master answer sheet.

The following notes provide additional information for you to discuss with your class. Incorporate the ideas you find here with your own ideas and make these points at the appropriate place in the discussion of the exercise.

Question A - The correct answers are 2, 3, and 5. During the course of regular inspections, federal inspectors or company personnel would have observed that roof bolts were incorrectly placed too far apart (1) or that high fall areas were improperly rebolted (4) or that inappropriate types of bolts have been installed (6). Moreover, the mine operator is required to follow an approved roof control plan and these items are specified in that plan. All miners should be capable of observing the many indicators of potential ground control problems. Three of these are noted in the correct answers to this question. Fresh sloughing from the ribs (2) is generally a sign that the ribs are taking on pressures from above. One obvious cue of this situation is the absence of rock dust in a particular area where the surrounding rock is covered with rock dust. Mine roof where rock or coal has fallen from around bolts (3) leaving the bolt head and plate exposed (sometimes called chandelier roof) is potentially very unstable. These bolts are not supporting the roof. Finally, when roof bolts have been pulled into wood header boards (5) it is an indication that the bolt anchorage is intact; however, the layers of roof strata below this horizon are sagging. Such movement will result in both bolts and bolt plates being drawn into the headers. This condition is potentially hazardous and requires additional roof support.

Question B - In any roof condition that is suspect, the proper action is to inspect the roof from a safe distance. The correct answers are 7 and 10; these represent a cautious approach to examining a situation which may be a hazard. The recommended safe distance is arbitrary; however, it is not "under" the bad roof, as incorrect answer 9 suggests.

Question C - If there is any doubt in your mind about a particular roof or rib condition, it should be treated as a potential hazard (13). Even though similar looking immediate roof strata separation has, in the past, remained in place, there is no assurance that the roof depicted in Slide 2 will stay up.

Question D - The correct answer is 17. Sending one person to the face to call outside for assistance and stationing one person by the bad top to alert others who may be traveling in this direction is the proper response. Many miners will choose to use a pry bar and scale down the loose top. This may be acceptable if the miners are experienced in performing this task. However, this is not the type of activity a transit man routinely gets involved with and he could easily misjudge the seriousness of the condition and get hurt. Of course, Sammy has almost no experience in removing loose top and he would be foolish to attempt it.

Question E - The correct answer is 21. Some miners may confuse slips and cutter roof. Both begin as fractures in the mine roof. However, a slip (or small joint) in the mine roof is a more pronounced and distinct fracture than cutter roof. Other characteristics of slips and joints that distinguish them from cutter roof fractures is their unpredictable location and direction in the mine roof. Cutter roof, by definition, initially begins as a fracture plane in the roof rock parallel to the entry, and located at the roof-rib interface. The fracture propagates upward into the roof over the entry at an angle usually greater than 60 degrees. Classic cutter roof failure is usually attributed to abnormally high horizontal stresses in the mine roof. When the shear stress at the roof-rib interface exceeds the shear strength of the rock, cutter roof results. Slides 3, 4, and 5 show cutter roof from a distance and from close-up so that miners can learn to recognize the hazard.

Question F - Reporting the cutter roof condition (25) is the correct response. Timing is important in this situation because effective control of cutter roof is possible when support techniques are applied before the cutters advance into the mine roof above the bolt anchor horizon. Setting a line of posts (27) was the control technique selected here. This task should be completed by qualified persons.

Question G - The correct answers are 29, 31, and 32. These responses address the three main causes of cutter roof. The high horizontal stresses (29) can be a localized condition or part of a regional stress field. In either case, the failures result from the maximum component of the stress and they tend to occur in the entries and crosscuts that are perpendicular to the stress. Minor geologic structures such as clay veins, bedding planes, coal cleats, paleochannels, and rolls can lead to cutters (31). These are weaknesses in the roof strata and create zones where the roof can move or sag. A relatively strong immediate roof, combined with weaker strata from above that tend to sag and statically load the immediate roof below, is also a condition that can lead to cutter failure (32).

Question H - The correct answer is 35. Cutter failure is a shear type action that generally starts at one roof-rib interface line and, if additional support is not installed soon, will extend up into the roof above the bolt horizon and down the other side of the entry. The entire entry does not become unstable unless the fracturing continues unabated.

References

Aggson, James R., Stress-Induced Failures in Mine Roof, Bureau of Mines RI 8338, 1979, 16 pp.

Bauer, Eric R., The Effectiveness of Angle Bolting to Support Cutter (Shear) Roof at Warwick No. 3 Mine, Bureau of Mines, Internal Report No. 4388, 1982, 21 pp.

Hill, John L., Cutter Roof Failure: An Overview of the Causes and Methods for Control, Bureau of Mines IC 9094, 1986, 27 pp.

Moebs, Noel N., Appalachian Roof Instability, Coal, March, 1989, pp 43-45. 12

Scoring Key for Sammy's Loose Roof Decision

The correct answers are marked with an asterisk.⁴

Question	Answer Number					
A	1	2*	3*	4	5*	6
B	7*	8	9	10*		
C	11	12	13*	14		
D	15	16	17*	18	19	
E	20	21*	22	23		
F	24	25*	26	27		
G	28	29*	30	31*	32*	
H	33	34	35*	36	37	38

⁴ This page is printed in large type so that it may be copied and used as an overhead transparency.

Appendix A: Problem Booklet

Duplicate this copy of the problem booklet for use in your classes. **Booklets should be printed on only one side of the paper.** Each person in your class should have a problem booklet while they are working the exercise. The problem booklets are reusable.

You may obtain a copy of the problem booklet from MSHA, National Mine Health & Safety Academy, Dept. of Instructional Materials, 1301 Airport Road, Beaver, WV 25813-9426 phone 304-256-3257, fax 304-256-3368 or email to lord-mary@msha.gov.

Sammy's Loose Roof Decisions

Problem Booklet

Instructions

Read the problem situation described on the next page. Then, answer each of the 8 questions. Do them one at a time. Some questions will ask you to look at one or more 3-D slides. Follow the directions for each question. Look at the appropriate slide or slides, then continue on with the exercise. Don't jump ahead, but look only at the questions and slides to which you are directed. However, you may look back to earlier questions and answers at any time. Some questions ask you to select all of the answers that you think are correct. Other questions ask you to select only one answer unless you are told to "Try again!"

After you have selected a choice to a question, look up its number on the answer sheet. Select your answer(s) to each question by rubbing the developing pen between the brackets on the answer sheet. A hidden message will appear and tell you if you are right. When you have finished, you will learn how to score your performance.

Background

You are the transitman on a mine surveying crew and have been assigned a new helper, Sammy Spadd.

Sammy has one year of mining experience, mostly as an engineering trainee.

You normally hurry to get sights set at the end of a shift because incoming crews don't like to wait for new sight lines.

The mine is a drift opening with an average coal seam height of 5 1/2 feet.

Problem

During your routine survey work in recent weeks, you observed that an idle section in 2 North mains, about 3 miles from the portal, has been experiencing serious roof problems. You were told by one of the mine engineers that the problems are due to the sudden presence of slips in the roof running in the direction of mining. Several falls and significant downtime have forced the company to reconsider the development of 2 North. On this particular day the general superintendent informs you and Sammy that the company decided to reactivate the idled section beginning next shift. You are to set sights in 2 North to re-orient all the entries by 45 degrees to the east. You are to begin your work before the regular daylight crew arrives.

Turn to the next page and do Question A.

Question A

You and Sammy have your gear assembled and are ready to go underground. You enter the portal and travel to 2 North in a track-mounted supply jeep.

What are some things you should watch for? (Select as MANY as you think are correct)

1. Roof bolts that are spaced too far apart.
2. Fresh spalling from the ribs.
3. Areas where the immediate roof has fallen from around the bolt head.
4. Bolts that are placed in isolated areas of high roof.
5. Roof bolts that are pulled into wood header boards.
6. Installation of inappropriate types of bolts.

When you have made your selection(s), do the next question.

Question B

As you and Sammy continue traveling to the section, you come upon a track switch. Sammy gets out of the jeep to throw the switch. He observes a low spot (sometimes called a "brow") in the roof a few feet in by the switch area. LOOK AT SLIDE 1.

What should Sammy do at this point? (Select as MANY as you think are correct)

- 7. Without going under the low spot, visually inspect the top from a safe distance.
- 8. Throw the switch and wave you ahead.
- 9. Move under the low spot, then visually inspect and sound the roof.
- 10. Move closer to the low spot and sound the roof.

When you have made your selection(s), do the next question.

Question C

Sammy throws the switch and you drive forward in the jeep. As you and Sammy pass the low spot, you look back. Here is what you see. LOOK AT SLIDE 2.

What should you make of the situation? (Choose only ONE unless you are told to "Try Again!")

- 11. This section of top will probably fall eventually but it isn't an immediate hazard.
- 12. You have seen situations like this before and the roof remained intact, so don't be overly concerned.
- 13. This section of roof is a potential hazard.
- 14. Since you and Sammy are in by the low spot and time is critical, continue going to the section so you can begin surveying.

Question D

Now that you and Sammy have identified this condition as a hazard, what should you do about it? (Choose only ONE unless you are told to "Try Again!")

15. Continue on your way with Sammy and report the bad top when you get to the section.
16. Look around for some timbers, and then, set a few posts.
17. Send Sammy to the section to call out and report the bad roof condition while you wait at your present location.
18. Take the pry bar from the jeep and scale down the bad top.
19. Take the jeep outby to the portal so you and Sammy can report the bad top and warn the incoming miners.

Question E

Two experienced roof control persons respond to Sammy's call and come to take care of the problem. Meanwhile, Sammy comes back, picks you up, and you head for the section. Now, because of the delay, you are behind schedule and in a hurry to start setting new sights. In the process of making a visual inspection of the workplace this is what you see outby the face in the first entry where you planned to begin surveying. LOOK AT SLIDES 3, 4, and 5.

What should you suspect? (Choose only ONE unless you are told to "Try Again!")

- 20. Moisture accumulating along the roof/rib interface has caused the rockdust to fall away.
- 21. The immediate roof was loaded by moving strata from above and this led to fracturing at the roof-rib interface.
- 22. A slip developed along the left rib similar to what the section has been experiencing lately.
- 23. Bad mining practices were followed by the continuous miner operator.

Question F

You have identified the problem as cutter roof. To begin your work you need to send Sammy 100 feet outby for a backsight. He will be near the cutter roof area.

What should you do now? (Choose only ONE unless you are told to "Try Again!")

- 24. Begin surveying for the new entry sight lines.
- 25. Tell Sammy to keep people out of that entry while you call out and report the condition.
- 26. Don't worry about the roof conditions. It probably has been there a few days and poses no serious hazard.
- 27. Begin setting a line of posts along the rib in the affected area.

Question G

Because you called out to report the hazardous roof condition, the general foreman sent in a crew to take care of the cutter roof problem. They placed a line of wood posts along the rib extending for approximately 40 feet down the entry. The top will be watched for further crumbling at the interface of the roof and rib. Cutter roof can advance if the affected area is not adequately supported. You and Sammy can now safely set sights in 2 North.

All underground workers should know how to recognize the beginning stages of cutter roof and understand the reasons for this type of roof hazard. LOOK AT SLIDE 6. It shows an example of cutter roof in its initial development.

Which conditions usually cause cutter roof? (Select as MANY as you think are correct)

- 28. Multiple seam mining.
- 29. High horizontal stresses within the mine roof.
- 30. Cutting the entry too wide.
- 31. Clay veins running along one side of an entry near the rib.
- 32. Variations in strength of individual roof strata.

When you have made your selection(s), do the next question.

Question H

Which one of the following statements about cutter roof is true? (Choose only ONE unless you are told to "Try Again!")

- 33. If the crumbling and flaking of the mine roof produces a channel only an inch or two deep, there is little danger of a major roof fall.
- 34. If the crumbling and flaking of the roof produces a channel about an inch or two deep, only the immediate mine roof has moved.
- 35. Cutter roof will generally fail in shear at one rib line.
- 36. If the cutter roof produces only a very narrow crumbling zone, the pillar has probably shifted slightly and widened the entry.
- 37. A cutter along one side of an entry is usually not a serious hazard.
- 38. Cutter roof only occurs in mines that have shales and thin bedded sandstones in the immediate roof.

End of Problem

Scoring your performance

- 1. Count the total number of responses you colored in that were marked "correct". Write this number in the first blank on the answer sheet.
- 2. Count the total number of "incorrect" responses you colored in. Subtract this number from 25. Write the difference in the second blank on the answer sheet.
- 3. The best score is 38. The worst score is 0.

Appendix B: Answer Sheet Blanks

These are the answer sheet blanks. Copies of these blank answer sheets may be duplicated in the normal fashion. However, the answers that are found within the brackets must be printed on these blank answer sheets in invisible ink. These answers are found in Appendix C. If you have the capability to print invisible ink, make copies of the blank answer sheets. Make a master of the answers that appear in Appendix C. Then print the invisible ink on the blank answer sheets, being careful to make sure all pages print and that the appropriate answers line up with the appropriate blanks. The Master Answer Sheet shows all the answers in their proper places.

Most companies and trainers prefer to obtain copies of the preprinted answer sheets from MSHA, National Mine Health & Safety Academy, Dept. of Instructional Materials, 1301 Airport Road, Beaver, WV 25813-9426 phone 304-256-3257, fax 304-256-3368 or email to lord-mary@msha.gov.

The exercise is designed to be used in small groups. You will need one answer sheet for each group of 3 to 5 persons in your class. The answer sheets are consumable. You will need a new set for each class.

A developing pen is also needed by each person who marks an answer sheet.

Answer Sheet for Sammy's Loose Roof Decisions

Use this answer sheet to mark your selections. Rub the developing pen gently and smoothly between the brackets. Don't scrub the pen or the message may blur. Be sure to color in the entire message once you have made a selection. Otherwise you may not get the information you need.

Question A (Select as MANY as you think are correct)

1. []
2. []
[]
3. []
[]
4. []
5. []
6. []
[]

Question B (Select as MANY as you think are correct)

7. []
8. []
9. []
10. []

Question C (Choose only ONE unless you are told to "Try Again!")

11. []
[]
12. []
[]
13. []
14. []
[]

Question D (Choose only ONE unless you are told to "Try Again!")

15. []
16. []
[]
17. []
[]
18. []
19. []

Question E (Choose only ONE unless you are told to "Try Again!")

20. []
21. []
[]
[]
22. []
[]
23. []
[]

Question F (Choose only ONE unless you are told to "Try Again!")

24. []
25. []
[]
26. []
27. []
[]

Question G (Select as MANY as you think are correct)

28. []
 []
 []
29. []
 []
30. []
 []
 []
31. []
 []
32. []
 []

Question H (Choose only ONE unless you are told to "Try Again!")

33. []
34. []
35. []
 []
36. []
37. []
 []
38. []
 []

Finding your score

Number of "Correct" answers you colored in = (1)_____

25 minus number of incorrect answers you colored in = (2)_____

Add blanks one and two to get your total score = (3)_____

Highest possible score = 38

Lowest possible score = 0

Appendix C: Invisible ink Answers

These pages contain the answers that must be printed in the blanks of the answer sheet in Appendix B. These answers are spaced and sequenced correctly so that they exactly match up with the appropriate blanks on the answer sheet blank.

Once the answers have been printed in the answer sheet blanks, the developing pen reveals the formerly invisible printed message.

You may obtain preprinted answer sheets or you may prepare your own copies. To learn more about these options, and to determine how many answer sheets and developing pens you will need, see the introductory section of the Instructor's Copy.

This problem should have been noticed a long time ago.

Correct. Absence of rockdust is often a cue that ribs are taking on vertical pressures.

Correct. This condition indicates that those particular bolts can no longer effectively support the roof.

High bolted roof indicates a previous fall that was rebolted following cleanup.

Correct. This can indicate excessive internal roof pressures.

Engineers determine bolt types based on makeup of the mine roof and these bolts must be approved in the roof control plan.

Correct. He looks carefully and the top appears to be OK.

Sammy should suspect a possible hazard.

This could be dangerous.

Correct. It sounds a little drummy, but not too bad.

All potential roof hazards should be treated as an immediate problem.
Try again!

You should be concerned for the safety of others as well as your own.
Try again!

Correct. It could fall at any time. Do the next question.

The shift crew, and others, soon will be moving through this main track entry.
Try again!

You need to act now. Try again!

This is dangerous. You don't have the proper tools and equipment. Try again!

Correct. The bad top needs to be reported right away, but you should stay to warn the miners coming in. Do the next question.

If you try this, a large section of roof may fall on you. Try again!

You shouldn't go back under the bad top. Try again!

This is unlikely. Try again!

Correct. Abnormally high stresses at the roof-rib interface have exceeded the shear strength of the rock. This produces the condition known as cutter roof. Do the next question.

A slip would have a clearly defined break line and would tend to run more toward the center of the entry roof. Try again!

Poor continuous mining machine operation would not produce a roof pattern like this. Try again!

This could be dangerous, particularly for Sammy. Try again!

Correct. Cutter roof is a serious problem. A large section of top may fall suddenly. Do the next question.

All potential roof hazards should be treated as serious problems. Try again!

This could be dangerous and should be done only by experienced miners with the necessary tools and materials. Try again!

If pillars are not stacked when mining above or below a mined out seam, roof and floor problems can occur. However, the nature of such ground failures are similar to those experienced in a common roof fall.

Correct. Classic cutter roof failure is usually attributed to high stresses which exceed the shear strength of the rock at the roof-rib interface.

This generally will increase the vertical stress in the stratified roof and result in tension fractures near the center of the roof span but will not cause cutter roof.

Correct. Clay veins can lead to cutter roof problems because they represent zones of weakness in the roof strata where the roof can sag and fracture.

Correct. A strong immediate roof can be loaded by weaker upper strata that may sag and induce cutters.

Try again!

Try again!

Correct. The cutter will work its way up from the roof-rib interface nearly vertically into the mine roof on one side of the entry. **End of Problem.**

Try again!

This is a hazard! However, when additional support is added at the first sign of cutters, the entry roof can become stabilized. Try again!

Cutter roof can and does occur in mines with many different roof compositions. Try again!